

Gasoline Dispensing Facility (GDF) Hose Emissions Workshop



September 28, 2006

California Air Resources Board

New Web Site

<http://www.arb.ca.gov/vapor/gdfhe/gdfhe.htm>

Presentation Outline

1. **Objective**
2. GDF Hose Background
3. Previous Work
4. Ongoing Work
5. Future Work
6. Projected Timeline
7. Comments & Contact Information

Objective

- Evaluate the feasibility of setting an emissions standard for GDF hoses
 - Currently, there is no standard regulating emissions from GDF hoses in California

Presentation Outline

1. Objective
2. **GDF Hose Background**
3. Previous Work
4. Ongoing Work
5. Future Work
6. Projected Timeline
7. Comments & Contact Information

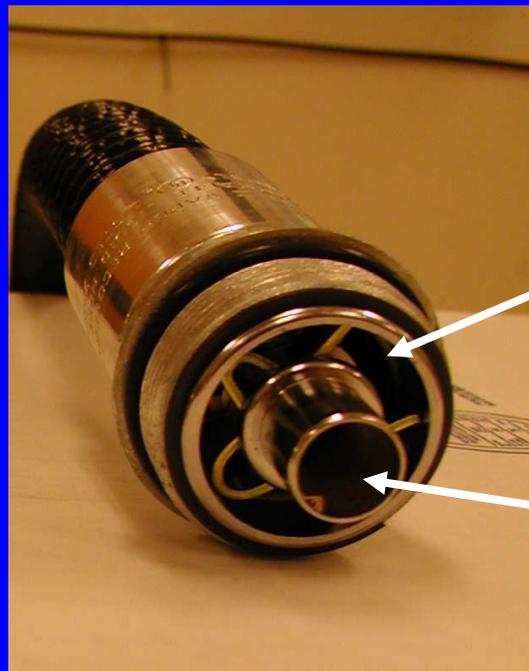
GDF Hose Background

- GDF Hose Coaxial Design
- GDF Hose Configurations
- Difficulties In Applying Standard Hose Permeation Tests

GDF Hose Background

GDF Hose Coaxial Design

- GDF hoses differ from other types of fuel hose in that they are co-axial, or have two paths, to allow for vapor recovery during fueling
 - Liquid path
 - Vapor path



Vapor Path

Liquid Path

GDF Hose Background

GDF Hose Configurations

- There are 2 major configuration types of GDF hose

- Vacuum Assist
- Balance



- The operational difference between them is that:
 - The balance hose carries liquid on the inner path and vapor on the outer path
 - The opposite is true for vacuum assist hoses

GDF Hose Background

Difficulties In Applying Standard Hose Permeation Tests

- Due to the coaxial design of GDF hoses, current fuel hose permeation test standards may not be applied without modification
- Balance hoses present an additional hurdle due to the vapor path being the outer path

Presentation Outline

1. Objective
2. GDF Hose Background
3. **Previous Work**
4. Ongoing Work
5. Future Work
6. Projected Timeline
7. Comments & Contact Information

Previous Work

- 2003 Emissions Estimate
- Estimated Cost of GDF Hose Upgrade
- Preliminary Testing Results
 - ARB GDF hose permeation testing
 - Manufacturer GDF hose permeation testing

Previous Work

2003 Emissions Estimate

- Initial GDF hose emissions estimate:
 - 3.0 tons/day of volatile organic compounds (VOCs)
- Assumptions:
 - Underwriter's laboratory (UL) 330 repeated bending test with maximum allowable loss of 30% of fuel
 - 2003 hose population estimate of ~ 135,000

Previous Work

Estimated Cost of Hose Upgrade

- Incremental retail cost increase based upon information from hose manufacturers (2005-06):
 - \$50 per hose
 - Based upon 5 responses ranging from \$0 - \$131
 - High and low outliers were eliminated
- Assumptions:
 - Hoses will meet a 5 g/m²/day emissions standard
 - Hoses are ~ 10 ft long
 - 1 – 4 year service life

Previous Work

Preliminary Testing Results

- 2004 ARB GDF hose permeation testing results:
 - 17 g/m²/day of VOCs (averaged)
 - 0.7 tons/day of VOCs
- The above numbers may underestimate the emissions because:
 - Hoses were only filled to 75%
 - Gasoline in the hoses was allowed to stagnate

Previous Work

Preliminary Testing Results

- 2006 industry submitted hose permeation testing results:
 - Greater than 200 g/m²/day of VOCs
 - Greater than 6 tons/day of VOCs
- The above numbers may overestimate the emissions because:
 - Testing at a constant temperature profile of 40 °C may bias results

Presentation Outline

1. Objective
2. GDF Hose Background
3. Previous Work
4. **Ongoing Work**
5. Future Work
6. Projected Timeline
7. Comments & Contact Information

Ongoing Work

- Re-Evaluating Emissions Estimates
- Re-Evaluating Cost-Effectiveness
- Developing Emissions Test Parameters
- Developing an Emissions Test Plan

Ongoing Work

Re-evaluating Emissions Estimates

- Current GDF hose emissions estimates:
 - 1 – 6 tons/day of VOCs
- Assumptions:
 - 2003 estimate
 - ARB testing results
 - Manufacturer testing results

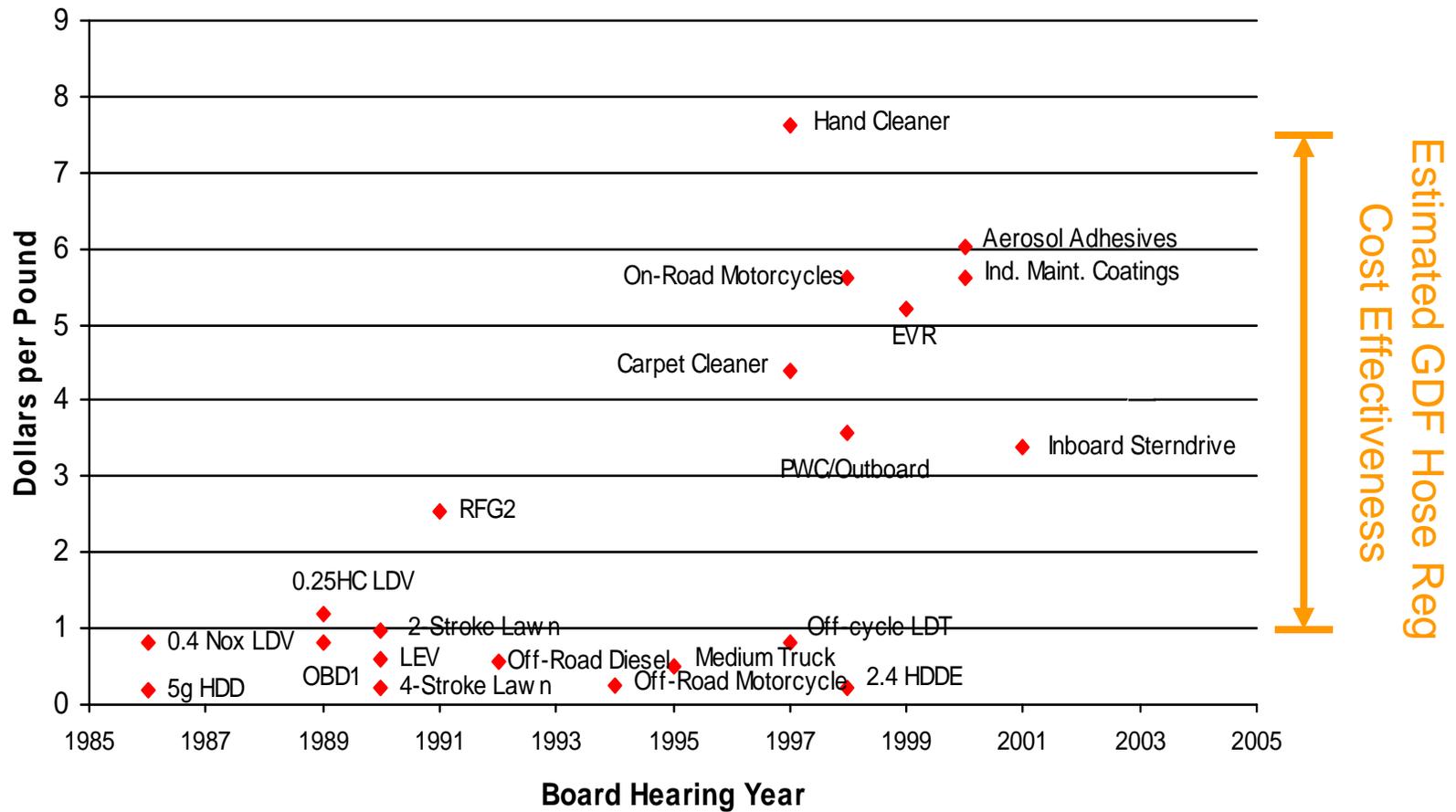
Ongoing Work

Re-evaluating Cost-Effectiveness

- Estimation of cost-effectiveness:
 - 1 – 7.50 \$ / lb of emissions
- Assumptions:
 - Emissions of 1 – 6 tons/day
 - 2005 hose population estimate of ~ 120,000
 - Hose upgrade cost of ~ \$50 per 10 ft hose
 - Permeation standard of 5 g/m²/day

Ongoing Work

Cost Effectiveness of Major Regulations



Ongoing Work

Developing Emissions Test Parameters

- Staff is currently developing a characteristic hose temperature profile
 - This will involve testing data from:
 - Static GDF hose temperatures
 - Field GDF hose temperatures
 - GDF tank temperatures

Ongoing Work

Static GDF Hose Temperature Testing

- Static hoses are hoses in which the liquid is not moving
- Purpose of the static temperature test is to record maximum possible liquid temperatures
- Testing status:
 - Concluded
 - Analyzing data

Ongoing Work

Static GDF Hose Temperature Testing

(Continued)

- The testing was performed with both configurations of hoses in varying degrees of sunlight
 - Full sun
 - Partial shade
 - Full shade



Ongoing Work

Static GDF Hose Temperature Testing

(Continued)

- Hose liquid paths are filled to 90% with commercial pump fuel
- Thermocouples are inserted into the liquid path of all hoses
- Thermocouples are also inserted into the vapor paths of the balance hoses
- Ambient along with all hose temperatures are recorded in data loggers

Balance →



Vac-assist →



Ongoing Work

Field GDF Hose Temperature Testing

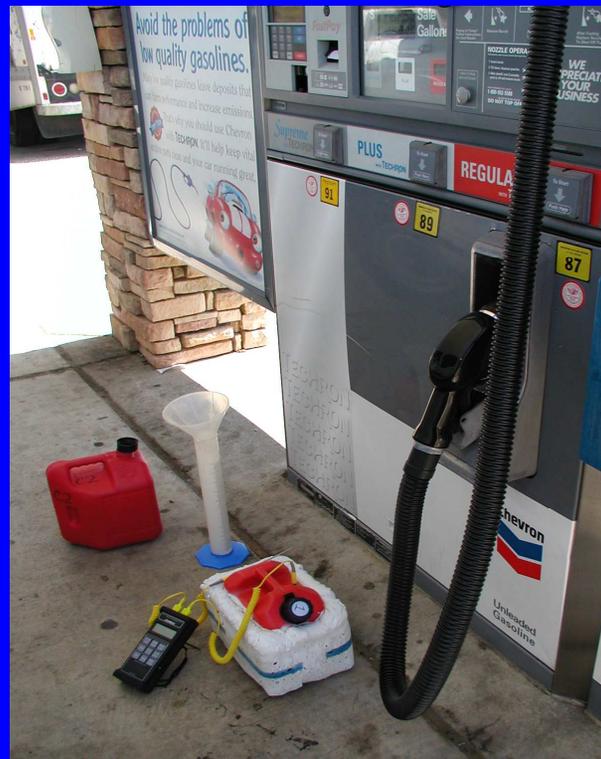
- Field hoses are hoses currently in use at GDFs
- Purpose of the field temperature test is to record actual liquid temperatures on in-use hoses
- Testing Status:
 - Ongoing

Ongoing Work

Field GDF Hose Temperature Testing

(Continued)

- The testing was performed with both configurations of hoses under both full shade and full sun conditions



Ongoing Work

Field GDF Hose Temperature Testing

(Continued)

- The hose contents are dispensed into an insulated gas can
- The fuel temperature is then taken and recorded along with ambient
- The fuel is then poured into a graduated cylinder to verify the amount dispensed, insuring that only fuel in the hose is tested



Ongoing Work

GDF Tank Temperature Testing

- Tank liquid temperatures refer to the fuel temperature in the GDF storage tanks
- The temperatures are collected via internal system monitors
- Purpose of the tank temperature test is to record a minimum hose temperature profile under most ambient conditions
- Testing Status:
 - Ongoing

Ongoing Work

Developing an Emissions Test Plan

- Current permeation test procedures which are being considered as possible test models include:
 - SAE J30
 - SAE J1527
 - SAE J1737
 - These tests cannot be adopted verbatim due to GDF hose coaxial designs
- A test plan for fugitive emissions at connectors is also being considered
- The ideal would be to develop a test procedure that could be incorporated into UL 330

Ongoing Work

Developing an Emissions Test Plan

(Continued)

- Steps necessary to develop a GDF hose emissions test procedure:
 - Request input from:
 - Underwriter's Laboratory (UL)
 - GDF hose manufacturers
 - Society of Automotive Engineers (SAE)
 - Verify the selected test procedure through testing

Presentation Outline

1. Objective
2. GDF Hose Background
3. Previous Work
4. Ongoing Work
- 5. Future Work**
6. Projected Timeline
7. Comments & Contact Information

Future Work

- Will Perform GDF Hose Emissions Tests
- Will Develop an Emissions Inventory
- Will Evaluate GDF Hose Regulation Feasibility
- If Feasible, Will Propose a Regulatory Package for Board Consideration

Future Work

Will Perform GDF Hose Emissions Tests

- In order to determine and evaluate a test procedure and develop an emissions inventory, staff will perform GDF hose emissions tests
- In order to accomplish this, ARB staff will:
 - Obtain a representative sample of test hoses
 - Procure a testing site
 - Follow an approved test procedure

Future Work

Will Develop an Emissions Inventory

- In order to properly state the emissions that are originating from GDF hoses, staff will develop an emission inventory
- Steps necessary for inventory development include:
 - Develop a GDF hose population
 - Survey the air quality management districts
 - Survey hose manufacturers for typical hose configurations
 - Calculate emissions factors for each hose configuration using test results
 - Apply GDF hose emissions factors across the population

Future Work

Will Evaluate GDF Hose Regulation Feasibility

- After a test procedure and an inventory have been developed, staff will then be able to determine feasibility
- Necessary steps for evaluating feasibility:
 - Determine control technologies available for meeting emissions reductions
 - Determine control technology cost-effectiveness

Future Work

Will Evaluate GDF Hose
Regulation Feasibility
(Continued)

- For the regulation to be feasible, a control technology must exist
- Necessary steps for determining available control technologies:
 - Obtain low emitting hose samples from hose manufacturers
 - Apply the emissions test procedure to samples

Future Work

Will Evaluate GDF Hose Regulation Feasibility

(Continued)

- For the regulation to be feasible, a control technology must be cost-effective
- Necessary steps for determining control technology cost-effectiveness:
 - Obtain cost estimates for low emitting hoses from manufacturers
 - Apply cost estimates against projected emissions reductions

Presentation Outline

1. Objective
2. GDF Hose Background
3. Previous Work
4. Ongoing Work
5. Future Work
6. **Projected Timeline**
7. Comments & Contact Information

Projected Timeline

- Projected completion dates of major milestones:
 - 2007
 - Develop a GDF hose emissions test procedure
 - Workshop proposed test procedure
 - Perform emissions testing using the approved test procedure
 - Finalize a GDF hose emissions inventory
 - Perform feasibility evaluation
 - Workshop test results, emissions inventory and feasibility
 - 2008 (If GDF hose regulation is feasible)
 - Draft staff's proposal
 - Workshop staff's proposal
 - Present proposed regulation to the Board for consideration.

Presentation Outline

1. Objective
2. GDF Hose Background
3. Previous Work
4. Ongoing Work
5. Future Work
6. Projected Timeline
7. **Comments & Contact Information**

Comments

Contact Information

- For questions concerning GDF hose emissions:
 - Jason McPhee
 - Project Lead, Engineering Development and Testing Section
 - (916) 322-8116, jmcphee@arb.ca.gov
 - Jim Watson
 - Manager, Engineering Development and Testing Section
 - (916) 327-1282, jwatson@arb.ca.gov
- For questions concerning this emissions inventory:
 - Larry Hunsaker
 - Emission Inventory Analysis Section
 - (916) 324-7168, lhunsake@arb.ca.gov

